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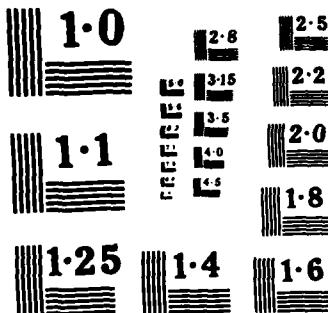
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17.	COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	differential equations, equilibrium figures, gauge theories
			and

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

During the period of this grant the single investigator wrote eleven research papers. He was on sabbatical. Titles included, "Vortex phenomena", "Some nonlinear analytic aspects of VLSI semiconductor device modeling", "The confinement problem in nonlinear guage theories", "New ideas in the calculus of variations in the large", "Variational principles for equilibrium figures of fluid without symmetry assumptions".

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FINAL REPORT ON AIR FORCE RESEARCH GRANT

During the period of this grant I wrote eleven research papers, edited one, major research symposium and supervised to completion the Ph.D.'s of two graduate students. My research was conducted on three main themes: First, explicit solution of a variety of nonlinear partial differential equations their integrability and the stability properties of such problems. In this area I wrote four major articles and found what I believe are major new approaches to this basic problem. I found a method to extend work in a finite degrees of freedom to infinite numbers in several space variables. This idea is reported on in papers [8], [10], and [11]. In addition, I extended my general notion of local analysis to more complicated stable singularity types (namely cusps) as reported in paper [7].

The second project that I studied involved new bifurcation phenomens as reported in papers [3], [12], and [9]. In paper [3] I showed now to introduce bifurcation in semiconductor device design qu-antitavely. In paper [9] I discuss bifurcation phenomena as they occur in classical mechanical systems describing periodic motions. In this way new computation methods discover new classas of periodic motions not previously known. Finally, in [12] I was able to carry out research on a new bifurcation phenomenon, nonlinear desingularization for type 2 superconductors. This work makes quantitative ideas which had previously been purely descriptive.

My third project describes constructive methods for im-

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plementing the calculus of variations for concrete physical
problems. Papers [2], [5], and [6] are devoted to this topic
and describe a whole new constructive point of view in calcu-
lating solutions for the relevant problem.

In addition to all this I organized and published a con-
ference promoting new connections between mathematics and science
and high technology in a nonlinear context based on the ideas
of J.C. Maxwell. This was the first conference of its type
and drew an enthusiasti-reception that is having important
ramifications in current research.

I supervision two Ph.D students to their Ph.D. degree with
Dr. P. Costa currently working at MIT-Lincoln Labs and Dr. Yi
Chen currently an assistant professor of math at Indiana University.
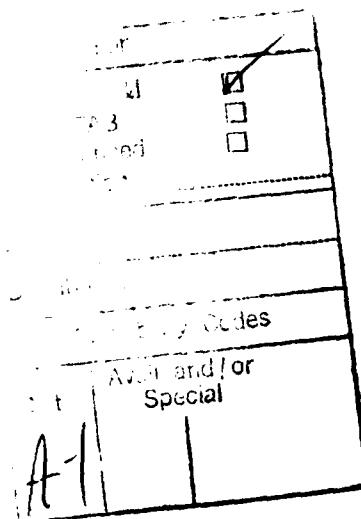
2 Ph'D thesis

1. P. Casta
2. Y. Chen

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(2) Berger, M.S., "Vortex Phenomena", Volume Studies in Global Analysis, Teubner Publishers, pp 34-42, 1983.

(3) Berger, M.S., "Some Nonlinear Analytic Aspects of VLSI Semiconductor Device Modelling", IEEE Transactions or Electron Devices, Volume 30, pp. 1181-3, 1983.

(4) Berger, M.S, "The Confinement Problem in Nonlinear Gauge Theories", The Maxwell Sesquicentennial Volume, pp. 179-184, 1984. North-Holland Publishers.

(5) Berger, M.S., "New Ideas in the Calculus of Variations in the Large", College de France Seminar in Nonlinear Differential Equations, Volume VI, Pitman Advanced Publishing Program, pp. 106-127, 1984.

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(7) Berger, M.S., "Folds and Cusps in Banach Spaces, with Applications to Nonlinear Partial Differential Equations I", with P.T. Church and J. Timourian, Indiana University Mathematical Journal, Volume 34, pp. 1-19, 1985.

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(9) Berger, M.S., "Global Aspects of Periodic Solutions for Nonlinear Conservative Systems", (to appear in Lecture Notes in Physics, Springer Verlag Volume Nonlinear Dynamical Systems), 1985.

(10) Berger, M.S., "The Diagonalization of Nonlinear Differential Operators", to appear in Proc. of the Symposium AMS-SIAM on Nonlinear P.D.E. of Applied Math, 1986.

(11) Berger, M.S., "Bifurcation and the Integration of Nonlinear Ordinary and Partial Differential Equations", (Choas and Nonlinear Dynamics Symposium to be Published by World Scientific), 1986.

(12) Berger, M.S., "Nonlinear Desingularization for Symmetric Vortices in the Ginsberg-Landau Equations", with Y.Y. Chen, submitted to Comm. Math Physics.

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